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EXPERIMENTS *on a* NEW EARTH *found near*
 STRONTHIAN *in* SCOTLAND. *By* RICHARD
 KIRWAN, *Esq; LL.D. F.R.S. and M.R.I.A.*

IN the mineral kingdom there are many substances whose distinctions are obvious; no one can be at a loss to distinguish earths from stones, or stones from metals, or the various metals from each other. The utility of these distinctions is as evident as the difference of characters on which they are founded is striking; but of late years lines of discrimination have been traced between substances, most of whose characters resemble each other so nearly, that they have ever before been deemed homogeneous. The discovery of these latent distinctions is often as important as that of the most obvious, and much more difficultly effected; thus the discovery of the difference between plumbago and molybdena led to the true knowledge of mineral coal; that of the difference between iron and manganese led

Read Jan.
 9, 1794.

to the more perfect knowledge of steel and iron ores ; that of the difference between barytic and common lime-stone led to the knowledge of a substance that is now a capital instrument in chemical analysis, and evinced the futility of that theory which deduced the origin of all substances that burned to lime from sea shells. The substance I now announce to the Academy affords a farther proof of the danger of too strict a reliance on general theories, and of the possibility of detecting many substances nearly allied to, but in reality differing from, those with which we are already acquainted. It is only after some years of diligent but fruitless research after such assimilating substances that this *possibility* may be deemed an *improbability*.

THE first account I received of this substance, which I shall call Stronthianite, was from Doctor Crawford in the year 1790 ; he was so obliging as to send me a specimen, accompanied with a letter, informing me that from some experiments he made it appeared to him to contain a new earth ; what these experiments were he did not mention.

SHORTLY after, however, it attracted some attention ; in the Miner's Journal of February 1791 a good description of its external appearance, and some account of its chemical properties, are given from the observations of Mr. Sulzer. I had not leisure to examine it until last October ; from the experiments I since made, in which I was assisted by Mr. Higgins, superintendent of our Apothecaries Hall, whose chemical abilities

ties are well known, and likely to be eminently useful to this country, it plainly appears to be a new earth, intermediate between the barytic and common limestone.

External Characters.

Its colour is whitish or light green.

Its lustre common.

Its transparency intermediate between the semitransparent and opaque.

Its fracture striated, presenting oblong distinct concretions, somewhat uneven and bent.

Its hardness moderate, being easily scraped. Very brittle.

Its specific gravity from 3,4 to 3,644.

SECTION

SECTION FIRST.

Its Relation to Heat and Fixed Air.

THIS stone exposed to a heat of 130° Wedgwood, in common clay crucibles, vitrifies very readily when in contact with the crucible, but the interior part remains unchanged. Having heated two ounces of it in a black lead crucible, only a very small part of it was vitrified; the remainder was converted into lime by a heat of 140° , and lost 194 grs. that is, little more than 20 per cent. of its weight; subsequent experiments shewed that the weight thus lost is fixed air, and that the loss is still greater than this experiment indicates, as by reason of the partial vitrification it cannot be perfectly ascertained.

EQUAL parts quartz and Stronthian lime, melted in a heat of 138° , partly into an amber yellow glass, and partly into a black and white enamel, the surface presented a strong lead-coloured metallic glaze, which was communicated even to the interior of the crucible and to its cover.

Two parts of this lime and one of magnesia being heated to 138° , the lime vitrified with that part of the crucible with which it was in contact into a porcelain mass, and acquired a purplish and greenish colour; the magnesia remained unaltered.

FOUR

FOUR parts Stronthian lime, and one of filex, heated to 138° , partly hardened and partly melted; but as the crucible was considerably acted upon, the genuine effects of these proportions is not clear.

THREE parts Stronthian lime and one part argill, heated to 150° , melted into a black compact mass, of which the upper part was an enamel, and the lower a porcelain, not having been sufficiently heated. The same experiment made with common lime produced only a porcelain.

TWO parts Stronthian lime and one of argill, heated to 150° , melted only where in contact with the crucible, the interior parts retained its powdery state; common lime used instead of Stronthian remained also in powder.

EQUAL parts Stronthian lime and magnesia retained their powdery state, except where in contact with the crucible.

FOUR parts filex and one of Stronthian remained unaltered at 147° , though the influx of melted coal seemed to convert them into a greyish black compact porcelain.

A COMPOUND formed of 67 parts filex, 23 of argill, and 10 of Stronthian lime, melted at so low a heat as 114° into a greyish white porcelain, which in a heat of 147° only became porous. When common lime was used instead of Stronthian the compound melted at 145° into a semitransparent frothy enamel.

mel. Hence we see this stone may be advantageously substituted for lime in pottery and vitrification, and, in metallurgy, as a flux for certain refractory ores.

WATER poured on Stronthian lime heats more violently than with the same proportion of common lime; it also dissolves it much more copiously, 200 parts of water dissolving one of this lime, or rather more; for a troy pound of water, temperature 60° , dissolves 36 grs. of this lime.

THE most remarkable property of this lime is that it is capable of crystallizing; a saturated solution of it, being suffered to stand for one day in a cool place, shot into transparent rhomboidal crystals, two of whose opposite angles were very acute, and the other two consequently very obtuse; these crystals do not readily effloresce by exposure to the air of the temperature of 66° , but placed on a hot iron they fall into powder which is still in the state of lime; the water deprived of them forms a pellicle on the surface like common lime-water; the crystals themselves are also soluble with the assistance of heat.

THE lime-water has a stronger taste, though of the same kind as that of the common; like this, it precipitates metallic solutions, and particularly that of sublimated corrosive with the same colour, but much more copiously than the common.

It is a much better test of fixed air than common lime-water, being precipitated much more abundantly by the smallest particle of that air.

WATER

WATER, thus impregnated, absorbs hepatic air in great quantity, and thus forms a Stronthian hepar. Marine acid, added to this liquid hepar, produced a pale bluish precipitate, accompanied with some effervescence.

STRONTHIAN-LIME is precipitated from its solution in water like the common by spirit of wine.

SECTION SECOND.

Of its Relation to Acids.

To discover its rank in the series of bodies subjected to the action of acids, I found it necessary previously to examine some anomalous experiments relative to the powers of common quick-lime, which, if left undetermined, would diffuse their obscurity over those which I meant to institute on Stronthian lime.

ABOUT the year 1779, Mr. Sage of the Royal Academy of Paris, and Doctor Demeste, asserted that quick-lime was a different earth from the calcareous; and, to prove this difference, they affirmed that lime-water precipitated a solution of gypsum, and also of lime-stone in the nitrous and marine acids. M. Morveau, in examining the nature of various calcareous compounds, allowed the truth of this experiment, and at that time

attributed this precipitation to the phlogiston of lime*. This explanation not appearing to me sufficiently satisfactory, I made the following experiments:

1°. HAVING diluted some quantities both of nitrous and marine acids with distilled water, I saturated both with Carrara marble; another portion of this marble I converted into lime, and of this lime I formed lime-water.

2°. To small portions of the solutions of this marble in each of the above-mentioned acids I added lime-water; in each a flaky and somewhat brownish white precipitate appeared.

3°. THIS precipitate was not soluble by an addition of pure distilled water.

4°. NEITHER was it increased by an addition of more lime-water; yet it was so small that I could not conceive it to contain all the calcareous earth in the nitrous and marine solutions.

5°. THE liquor in which this precipitate appeared being filtered, and the precipitate, thus separated, more lime-water was added to the filtered liquor, but no precipitate appeared; yet on dropping into this liquor a fresh quantity of marine selenite a cloud was immediately discernible.

* See 17 Rozier for 1781, p. 218, 224 and 227.

6°. THE

6°. THE solution of marine selenite being slightly boiled, lime-water was added to it; a cloud still appeared, but the precipitate was much less copious than when the unboiled solution was used.

7°. To a solution in the nitrous acid, not of marble, but of lime formed of marble, lime-water was added; no precipitate or cloudiness ensued.

HENCE it is clear that the precipitation, formed by the addition of lime-water to the acid solutions of Carrara marble, consisted of the lime itself contained in the lime-water, and not of that united to the mineral acids, being occasioned by the fixed air absorbed by those acid solutions after or during its extrication in the act of solution; for this precipitate must be either argill, magnesia or calcareous earth; if it were argill or magnesia the precipitate would be as copious from a boiled as from the unboiled solution, the contrary of which we have seen in the 6th experiment; it should also be found in the acid solutions of lime, which is contradicted by the 7th experiment; if it were an earth separated from an acid it should be in the state of lime, and consequently soluble by an addition of more water, contrary to the 3d experiment; but if we suppose it a calcareous earth, precipitated from the lime-water by the fixed air contained in the acid solutions, all the phenomena exhibited by these experiments must naturally occur. This air will precipitate the lime in the lime-water added, as in the 2d expe-

riment. This precipitate will be infoluble in water as in the 3d; the addition of more lime-water will not increase it, as is seen in the 4th, all the fixed air being already taken up; but on adding to this mixed liquor more of the acid solutions a precipitate will appear as these acid solutions convey an additional quantity of fixed air, which acts on the lime-water contained in the mixed liquor, as in the 5th experiment; the precipitate will be less copious in the boiled solutions, as much of the fixed air is expelled by the boiling, as in the 6th experiment; and finally, no precipitate will be formed in the acid solutions of lime, as in that case no fixed air can exist.

THIS source of ambiguity being removed, I now proceed to the experiments made to discover the relation of Stronthianite to acids.

To the Marine.

STRONTHIANITE dissolves very readily in the marine acid, whether concentrated or diluted, and with considerable effervescence; 100 grains of Stronthianite lose by solution in acids 26,5. Common lime-stones, equally free from foreign mixture, contain much more fixed air; barytic lime-stones much less, and are more difficultly soluble.

THE acids of vitriol, tartar and sugar, being successively dropped into this muriatic solution, instantly produced copious precipitates still more infoluble than those that arise from their union with common calcareous earth.

THIS

THIS solution is also precipitable by mild alkalis, whether fixed or volatile, and apparently so by the fixed caustic vegetable alkali; but the caustic volatile produced only a slight cloud, proceeding, as I imagine, from its not being perfectly caustic.

MILD calx caused also a precipitation of Stronthian from this solution, but mild barytes none.

COMMON lime-water produced a precipitate in this solution from the causes already mentioned; but barytic lime-water caused a copious precipitate.

ALL neutral salts, formed by the vitriolic acid united to any basis, such as the solutions of tartar vitriolate, glauber, vitriolic ammoniac, selenite, epsom, alum, and of the vitriols of zinc, lead, mercury, tin, bismuth, regulus of antimony, produced copious white precipitates, that of iron a brown.

BUT neither iron, copper, tin or lime, in their metallic forms, caused any change in our solution, at least in a short time. This solution, being evaporated nearly to $\frac{1}{2}$ its bulk, shot into crystals soluble in their own weight of water of the temperature of 68°. At 78° or a still higher heat they effloresce.

To the Nitrous Acid.

THIS stone is scarce at all attacked by nitrous acid whose specific gravity is 1,4, but if to this acid half its weight of
water

water be added, so that its specific gravity be about 1,3, it is gently soluble; but if nearly its own weight of water be added to it, so that its specific gravity be 1,22, it effervesces violently, whereas barytes is nearly insoluble in an acid even thus diluted. This solution also crystallizes; and, if the evaporation be slow, into large crystals; by spontaneous evaporation I have obtained some of the weight of 14 grains, and if the quantities were large their size would undoubtedly be greater. Their shape was that of flat hexahedral lamellæ imbricated, that is, superimposed on each other, as flakes on the roof of an house.

THESE crystals are soluble in somewhat more than their weight of water heated to 66°. Placed on a red-hot iron they decrepitate like common salt, and fuse in a still stronger heat.

THE saturated solution of this earth does not discolour litmus, as that of barytes does.

To the Acetous Acid.

THIS stone is also soluble, though much more slowly, in distilled vinegar. The solution being carefully evaporated shoots into stelliform crystals, of an acid taste; they effloresce by exposure to the air.

To the Vitriolic Acid.

THIS acid, when concentrated, has scarce any action on this stone, whether mild or calcined. When much diluted I found 10,000 parts of it to dissolve one of this stone.

SECTION

SECTION THIRD.

Of the Affinities of Stronthian.

STRONTHIAN lime-water, poured on a solution of tartar vitriolate, immediately formed a precipitate, and so it did in the solution of glauber's salt and vitriolic ammoniac; hence its affinity to vitriolic acid is superior to that which any alkali bears to this acid.

It also formed a precipitate in the solutions of common felinite, epsom and allum; hence the affinities of common lime, magnesia and argill, to the vitriolic acid, are inferior to those of this earth.

BUT barytic lime-water decomposes the compound of vitriolic acid and Stronthian, and also the combinations of this earth with the nitrous, muriatic and acetic acids.

HENCE the affinities of Stronthian seem to be the same as those of barytes, but inferior in degree, though superior to those of common calx.